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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/798,726	03/11/2004	David Nister	SAR 14831	4988

58882 7590 04/05/2007

PATENT DOCKET ADMINISTRATOR
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EXAMINER	
ALLISON, ANDRAE S	
ART UNIT	**PAPER NUMBER**
2624	

SHORTENED STATUTORY PERIOD OF RESPONSE	MAIL DATE	DELIVERY MODE
3 MONTHS	04/05/2007	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

If NO period for reply is specified above, the maximum statutory period will apply and will expire 6 MONTHS from the mailing date of this communication.

Office Action Summary	Application No.	Applicant(s)	
	10/798,726	NISTER, DAVID	
	Examiner	Art Unit	
	Andrae S. Allison	2624	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *11 March 2004*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-24* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-24* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *11 March 2004* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date *1/7/2005*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

Claim Rejections - 35 USC § 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

2. Claims 1-3, 8-13, 16-18 and 21-24 are rejected under 35 U.S.C. 103(a) as being unpatentable over Quan et al (NPL Document titled "Linear N-Point Camera Pose Determination") in view of Zhang et al (Pub No.: US 2003/0044048).

As to independent claim 1, Quan discloses a method for determining camera pose (camera pose estimation, see abstract) from a plurality of point correspondences between at least two images (see page 774, [p][001], lines 1-3), comprising: selecting a plurality of five point correspondences from the plurality of point correspondences (see [p][006], lines 1-6, where 5 points linear points algorithms is used); generating at least one hypothesis from each of said five point correspondences; scoring said plurality of hypotheses for determining a best hypothesis; and generating rotation and translation information of said camera pose from said best hypothesis (see page 777, [p][006], lines 13-16, where depth information of the reference points are converted to a camera rotation and translation). However, Quan does not expressly mention generating at least one hypothesis from each of said five point correspondences; scoring said plurality of hypotheses for determining a best hypothesis. Zhang discloses a method for incremental motion estimation that includes generating at least one hypothesis from

each of said five point correspondences ([p][0010], lines 1-25); scoring said plurality of hypotheses for determining a best hypothesis (local bundle adjustment, [p][039-0045]). At the time of the invention, it would have been obvious to a person of ordinary skill in the art to have combined the teachings of Quan and Zhang for estimating the camera pose parameters associated with each image of a long sequence using local bundle adjustment approach ([p][0002], lines 1-6) by applying minimization technique such as the epipolar constraint, thereby reducing processing time (see [p][0013], lines 18-35).

As to independent claim 11, Quan discloses a method for determining camera pose (camera pose estimation, see abstract) from a plurality of point correspondences between at least two images (see page 774, [p][001], lines 1-3), comprising: the means for selecting a plurality of five point correspondences from the plurality of point correspondences is the linear five algorithm (see page 277, [p][006-007]); means for generating at least one hypothesis from each of said five point correspondences; means for scoring said plurality of hypotheses for determining a best hypothesis; and the means for generating rotation and translation information of said camera pose from said best hypothesis is the linear five algorithm (see page 277, [p][006-007]). However, Quan does not expressly mention the means for generating at least one hypothesis from each of said five point correspondences and the means for scoring said plurality of hypotheses for determining a best hypothesis. Zhang discloses a method for incremental motion estimation that includes the means for generating at least one hypothesis from each of said five point correspondences is the module (146, see Fig 1)

and the means for scoring said plurality of hypotheses for determining a best hypothesis is the module (146, see Fig 1). Therefore combining Quan and Zhang would meet the claim limitations for the same reasons as previously discussed in claim 1

As to independent claim 16, this claim differs from claim 1 only in that claim 16 is computer program product whereas claim 1 is method and the limitations a computer-readable medium having stored thereon a plurality of instructions and the instruction being executed a processor are additively recited in the preamble. Note the above Zhang clearly teaches a computer program product (computer-executable instructions, see [p][0030], lines 1-2) stored on a computer-readable medium (150, see Fig 1) having stored thereon a plurality of instructions (program modules, see [p][0030], lines 1-2) and the instruction being executed by a processor (120, see Fig 1).

As to claim 2, Quan teaches the method, wherein intrinsic parameters (e.g. focal length, see page 777, [p][0011], lines 7-8) associated with said plurality of point correspondences are considered calibrated (note that the image captured with a calibrated camera, see page 774, [p][001], lines 2-4).

As to claim 3, Quan teaches the method, wherein said intrinsic parameters include focal length (see page 777, [p][0011], lines 7-8).

As to claim 8, Zhang teaches the method, wherein said scoring step employs preemptive scoring (see [p][0051-0055]).

As to claim 9, Zhang teaches the method, wherein said preemptive scoring comprises: scoring said plurality of hypotheses against a subset of observations; and retaining a subset of said scored hypotheses (note that the local bundle adjustment is further process, see [p][0051-0055]).

As to claim 10, Zhang teaches the method, wherein said preemptive scoring further comprises: scoring said retained subset of said scored hypotheses against a larger subset of observations; retaining a subset of said second scored hypotheses; and repeating said scoring and retaining steps for a plurality of observations (note that the local bundle adjustment is further process, see [p][0051-0055]).

Claims 12-13 differ from claims 2-3 only in that claims 2-3 are method claims whereas claims 12-13 are apparatus claims. Thus, claims 12-13 are analyzed as previously discussed with respect to claims 2-3 above.

Claims 17-18 differ from claims 2-3 only in that claims 2-3 are method claims whereas claims 17-18 are computer-readable medium claims. Thus, claims 17-18 are analyzed as previously discussed with respect to claims 2-3 above.

Claims 21-23 differ from claims 8-10 only in that claims 8-10 are method claims whereas claims 21-23 are computer-readable medium claims. Thus, claims 21-23 are analyzed as previously discussed with respect to claims 8-10 above.

As to independent claim 24, all the limitations are discussed claims 1 and 9 above.

3. Claims 4, 6-7, 14 and 19 are rejected under 35 U.S.C. 103(a) as being unpatentable over Quan et al (NPL Document titled "Linear N-Point Camera Pose Determination") in view of Zhang et al (Pub No.: US 2003/0044048) further in view of Faugeras et al (NPL Document titled "Motion from Point Matches: Multiplicity of Solutions").

As to claim 4, neither Quan or Zhang expressly disclose the method, wherein said hypothesis generating step generates said at least one hypothesis from each of said five point correspondences by directly generating a tenth degree polynomial. Faugeras discloses a method of finding camera motions compatible with a given set of mage correspondences (see abstract) that includes hypothesis generating step generates said at least one hypothesis from each of said five point correspondences by directly generating a tenth degree polynomial (note that 5 image correspondences are used and 10 solutions are obtained, see page 237, [p][009], lines 1-11). At the time of the invention, it would have been obvious to a person of ordinary skill in the art to have combined the teachings of Quan as modified by Zhang and Faugeras to find camera

motions compatible with a given set of image correspondences based on the essential matrix and algebraic geometry, more specifically, given five image correspondences, exactly 10 camera motions are compatible (see page 241, [p][001], lines 1-8).

As to claim 6, note the discussion above, Faugeras teaches the method, wherein said rotation and translation information are derived from an essential matrix, E (see page 229, [p][003-004]).

As to claim 7, note the discussion above, Faugeras teaches the method, wherein said essential matrix E is a 3.times.3 matrix that satisfies: $EE^T E - \frac{1}{2} trace(EE^T)E = 0$ (see equation 11 on page 231).

Claim 14 differ from claim 4 only in that claim 4 is a method claim whereas claim 14 is an apparatus claim. Thus, claim 14 is analyzed as previously discussed with respect to claim 4 above.

Claim 19 differ from claim 4 only in that claim 4 is a method claim whereas claim 19 is a computer-readable medium claim. Thus, claim 19 is analyzed as previously discussed with respect to claim 4 above

4. Claims 5, 15 and 20 are rejected under 35 U.S.C. 103(a) as being unpatentable over Quan et al (NPL Document titled "Linear N-Point Camera Pose Determination") in

view of Zhang et al (Pub No.: US 2003/0044048) further in view of Faugeras et al (NPL Document titled "Motion from Point Matches: Multiplicity of Solutions") further in view of Brown (NPL Document titled "3D Head Tracking Using Motion Adaptive Texture-Mapping").

As to claim 5, Faugeras teaches the method, wherein said generating step generates said tenth degree polynomial comprises: extracting a nullspace of a 5.times.9 matrix; expanding in accordance with cubic constraints; applying Gauss-Jordan elimination; and expanding determinant polynomials of two 4.times.4 polynomial matrices to obtain said tenth degree polynomial directly (see page 236, [p][005-008]). However, Faugeras does not expressly disclose applying Gauss-Jordan elimination. Brown discloses a method for creating a set of motion templates ([p][006], lines 1-4)that includes applying Gauss-Jordan elimination (see page 2, [p][008], lines 1-8). At the time of the invention, it would have been obvious to a person of ordinary skill in the art to have combined the teachings of Quan as modified by Zhang and Faugeras with Brown to compute the best linear combination using lease squares on normal equations (see page 2, [p][008], lines 1-8). Furthermore, the Gauss-Jordan elimination method is well know in the art for solving large linear systems numerically by manipulating the given matrix using the elementary row operations to put the matrix into row echelon form.

Claim 15 differ from claim 5 only in that claim 5 is a method claim whereas claim 15 is an apparatus claim. Thus, claim 15 is analyzed as previously discussed with respect to claim 5 above.

Claim 20 differ from claim 5 only in that claim 5 is a method claim whereas claim 15 is a computer-readable medium claim. Thus, claim 20 is analyzed as previously discussed with respect to claim 5 above.

Conclusion

The prior art made part of the record and not relied upon is considered pertinent to applicant's disclosure.

Roy (US Patent No.: 6,580,821) is cited to teach a method for computing the location and orientation of an object in three dimensional space.

Taylor et al (US Patent No.: 6,980,690) is cited to teach a method for creating a 3-D model by processing images taken from a series of camera position.

Davison et al (US Patent No.: 6,647,146) is cited to teach a method an apparatus for creating a three-dimensional model of an object.

Navad et al (Pub No.: US 2003/0012410) is cited to teach a tracking and pose estimation for augmented reality using real features.

Astrom et al (Pub No.: US 2003/0030638) is cited to teach a method for extracting information from a target area.

Szelishi et al, (NPL document titled, "Matching 3-D anatomical surfaces with non-rigid deformations using octree-splines") is cited to teach a method for determining the minimal non-rigid deformation between two 3-D surfaces.

Mohr, (NPL document titled, "Relative 3D Reconstruction Using Multiple Un-calibrated Images') is cited to teach method for using reference points to create a relative 3D reconstruction using multiple un-calibrated images.

Heyden et al, (NPL document titled, "Reconstruction from Calibrated Cameras-A New Proof of the Kruppa-Demazure Theorem") is cited to teach a method for

reconstruction the location of five points in space form two different images taken by calibrated camera.

Hartley et al, (NPL document titled, "Reconstruction from two views using approximate calibration") is cited to teach a method for image reconstruction from two views using approximate calibration.

Inquires

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Andrae S. Allison whose telephone number is (571) 270-1052. The examiner can normally be reached on Monday-Friday, 8:00 am - 5:00 pm, EST.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Joseph Mancuso can be reached on (571) 272-7695. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

Andrae Allison

March 29, 2007

AA.

JOSEPH MANCUSO
SUPERVISORY PATENT EXAMINER